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NOTES ON GEOGRAPHIC DISTRIBUTION

Mammalia, Felidae, *Panthera onca* (Linnaeus, 1758): Recent records in east Mato Grosso do Sul, Brazil

Elson Fernandes de Lima*, Daniel Henrique Homem and Paul François Colas-Rosas

Casa da Floresta Assessoria Ambiental Ltda. Av. Joaninha Morganti 289. CEP 13415-030. Piracicaba, São Paulo, SP, Brazil.
* Corresponding author. E-mail: *elson@casadafloresta.com.br*

ABSTRACT: The largest neotropical feline is the jaguar *Panthera onca*, threatened with extinction in Brazil, where it can be found in almost all biomes. Here we report records of the specie in areas of *Eucalyptus* sp. productions with intense industrial expansion, where there has been no previous record of the species.

The jaguar *Panthera onca* (Linnaeus, 1758) is the largest feline in the Americas (Macdonald *et al.* 2010), with original distribution ranging from southwestern United States to almost every country in South America, except Chile (Eisenberg and Redford 1999; Sanderson *et al.* 2002). Its current distribution has been reduced to 46% of its former range, restricted to few sites in Mexico and extreme southwestern United States (the most boreal extension), extended to the southernmost region – southern Brazil (except the Pampas) and the Chacos in Argentina (Sanderson *et al.* 2002), considered locally extinct in Uruguay and El Salvador (Caso *et al.* 2011). The preferred habitat for this species is associated with watercourses, often with a high degree of conservation and prey abundance (Eisenberg and Redford 1999).

This species is affected by reduction and habitat loss, and especially due to hunting motivated by conflicts with ranchers that regard this feline as principally responsible for livestock losses (e.g. Perovic and Herrán 1998; Palmeira *et al.* 2008; Paviolo *et al.* 2008). However, according to the International Union for Conservation of Nature (IUCN), *Panthera onca* is only listed in the "near threatened" category because of its high survival probability in the Amazon Basin, Pantanal, and Chaco. These regions account for about 70% of their habitat, especially due to extensive continuous forest maintenance, low human density, and a high concentration of large protected area conservation (Caso *et al.* 2011).

In Brazil, this species is found in all biomes, except in the Pampas (Torres *et al.* 2008; Nascimento and Campos 2011), however in the Cerrado (savannah) and Atlantic Rainforest, where fragmentation and land use conversion for grazing and agriculture are more intense, recent *P. onca* records are scarce and geographically dispersed. Although there are some regions with high probability of long term survival, in much of these biomes the jaguar is supposed to be extirpated (Sanderson *et al.* 2002), so that Haag et al. (2010) have found differences in the genetic structure of isolated remnant Atlantic Rainforest populations in southeastern Mato Grosso do Sul, northwest Paraná, and southwest São Paulo, which were attributed to reduction of gene flow which have been caused by the loss of connectivity.

Haag et al. (2010) suggest that four sub-populations compose the current *Panthera onca* population in upper Paraná: i) Green Corridor - the border between Brazil and Argentina at Foz do Iguaçu, PR, ii) Ivinhema, in the Ivinhema State Park, MS, iii) Morro do Diabo, in the Morro do Diabo State Park, Brazil, and iv) Porto Primavera, in Porto Primavera dam, MS/SP until Três Irmãos dam, SP. The authors suggest that gene flow between populations from Ivinhema and Porto Primavera were most likely constant until filling up of the dam, when the population became sparse, with only a few individuals observed in recent years.

Figure 1 shows recent (< 20 years) and historical (≥ 20 years) recorded points for *P. onca* (Mares *et al.* 1981; Eisenberg 1989; Redford and Eisenberg 1992; Calouro 1999; Eisenberg and Redford 1999; Ortega-Huerta *et al.* 1999; Nuñes *et al.* 2000; Garla *et al.* 2001; Medellin *et al.* 2001; Rodrigues *et al.* 2002; Polisar *et al.* 2003; Scognamillo *et al.* 2003; Maffei et al. 2004; Silver *et al.* 2004; Durden *et al.* 2006; Haag *et al.* 2010; Moraes 2012), and as shown there were no recorded instances in the Três Lagoas region, MS.

We obtained three recent records in the field, which are here first reported. The records occurred in the Cerrado (savannah), "cerradão" and wetland forest physiognomies, one near the right bank of the Paraná River and the others on the proximity of its important tributary, Sucuriú River, all influenced by semi-deciduous forest. The regional landscape matrix was occupied by pastures, and it has being replaced in last few years by forest plantation of *Eucalyptus* for pulp production.

The Barra do Moeda Farm, property of Fibria Celulose S/A, is located in Três Lagoas, the far eastern section of Mato Grosso do Sul State (MS) (21°01'52" S, 51°47'18" W). The farm is about 5,624 hectares (ha), with 53.5% (2,986 ha) occupied by commercial *Eucalyptus* plantations and 34.2% (1,923 ha) by native vegetation, protected by Brazilian legislation (Federal Law No. 4.771 1965). The first record of *Panthera onca* was a footprint found after 15 campaigns (128 days in the field), sighted in February 2011 during medium and large mammals monitoring,

carried out on the Barra do Moeda Farm since August 2007 with quarterly campaigns.

The jaguar's paw is digitigrade and leaves footprints with dimensions of similar length and width, ranging from 9.0 to 11.0 cm of the posterior paw and 10.0 to 13.0 cm of the anterior, with generally rounded palmar pad and digits. On site, an anterior *Panthera onca*'s footprint was found in sandy substrate, which is suitable for printing traces, measuring 11.0 cm wide and 10.0 cm long (Figure 2a).

In the subsequent campaign of May 2011, the record was confirmed with photographic traps (camera-traps) installed in areas of native vegetation at the Barra do Moeda Farm (Figure 2b). Two of the three pictures were obtained from the same specimen, identified by the animal's spot pattern; the third picture, showing the opposite side, could not be individualized. These records were obtained from the same area of the farm, in a 3.0-km radius in less than 24 hours, between May 29 and 30, suggesting that the pictures correspond to the same individual.

The second site where the feline was recorded is at Perdizes Farm, a livestock ranch, at Três Lagoas municipality, MS (20°16'18" S, 52°05'25" W). A picture obtained by camera-trap (Figure 2c), in June 2012, was from the same side of the Barra do Moeda's specimen and it allow us to conclude that they are different animals because of the difference in the spotted pattern. This has an important conservation consequence because there are at least two individuals in less than 90 km, reinforcing that the region must be included at an actual distribution of the *P. onca*. The last point record occurred at Santa Lúcia do Sucuriú Farm, property of Eldorado Florestal, located also in Três Lagoas (20°08'11" S, 52°09'49" W), far from about 15 kilometers from Perdizes Farm. This property has the same proportion of native vegetation than Barra do Moeda Farm – about 28.9% (1,584 ha) and 68.2% (3,740 ha) of eucalypt plantation. This record was found in the first campaign of medium to large-sized mammals monitoring program at this property, in August 2012.

In conclusion, the locations where the specimens were found are excluded from the Extent of Occurrence in the Brazilian Cerrado (Moraes 2012) (Figure 1), highlighting the importance of these records. Moreover, this region of the country are not included in priority areas for creation of corridor in order to improve the jaguar distribution (Rabinowitz and Zeller 2010), therefore, we recommend that it should be revised. Furthermore, based on the observed distance of the closest records (80-140 km, in Três Irmãos dam, in São Paulo State and Porto Primavera dam, in Mato Grosso do Sul, respectively), possibly the individual recorded in Barra do Moeda Farm is a migratory member of the remnant sub-population of Porto Primavera or a member of Cerrado population. Locally, these records have strategic importance because the Barra do Moeda Farm is inside the Três Lagoas Industrial Park, with increasing industrial activity. In addition, the individual recorded in this farm was less than five kilometers from a pulp mill in the timber production area.

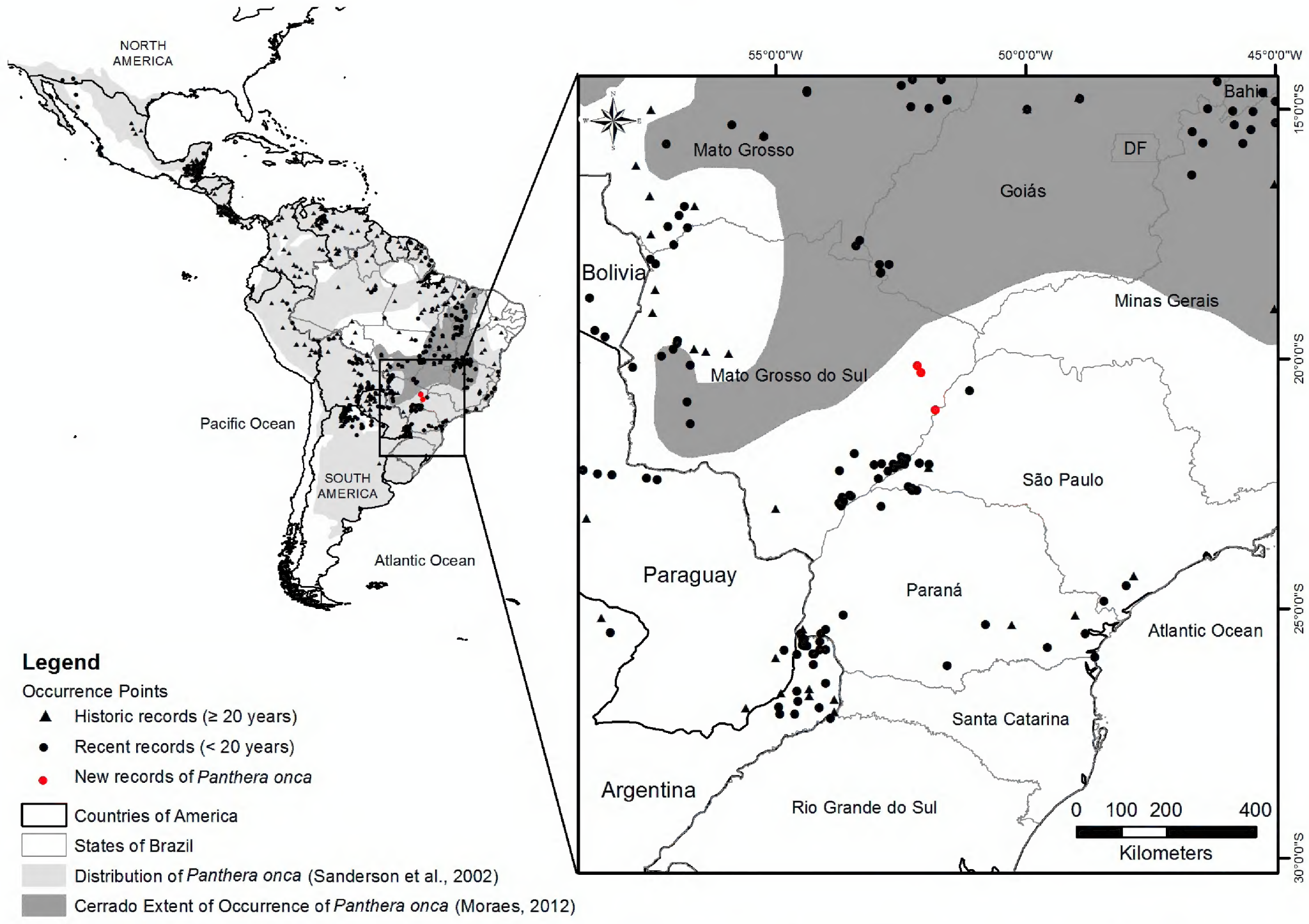

FIGURE 1. Map showing the original distribution area of *Panthera onca*, with occurrence points. Black triangles represent points of historical occurrence (≥ 20 years), gray circles represent points of recent occurrence (<20 years), and the red circles represents the sites of the reported counts.

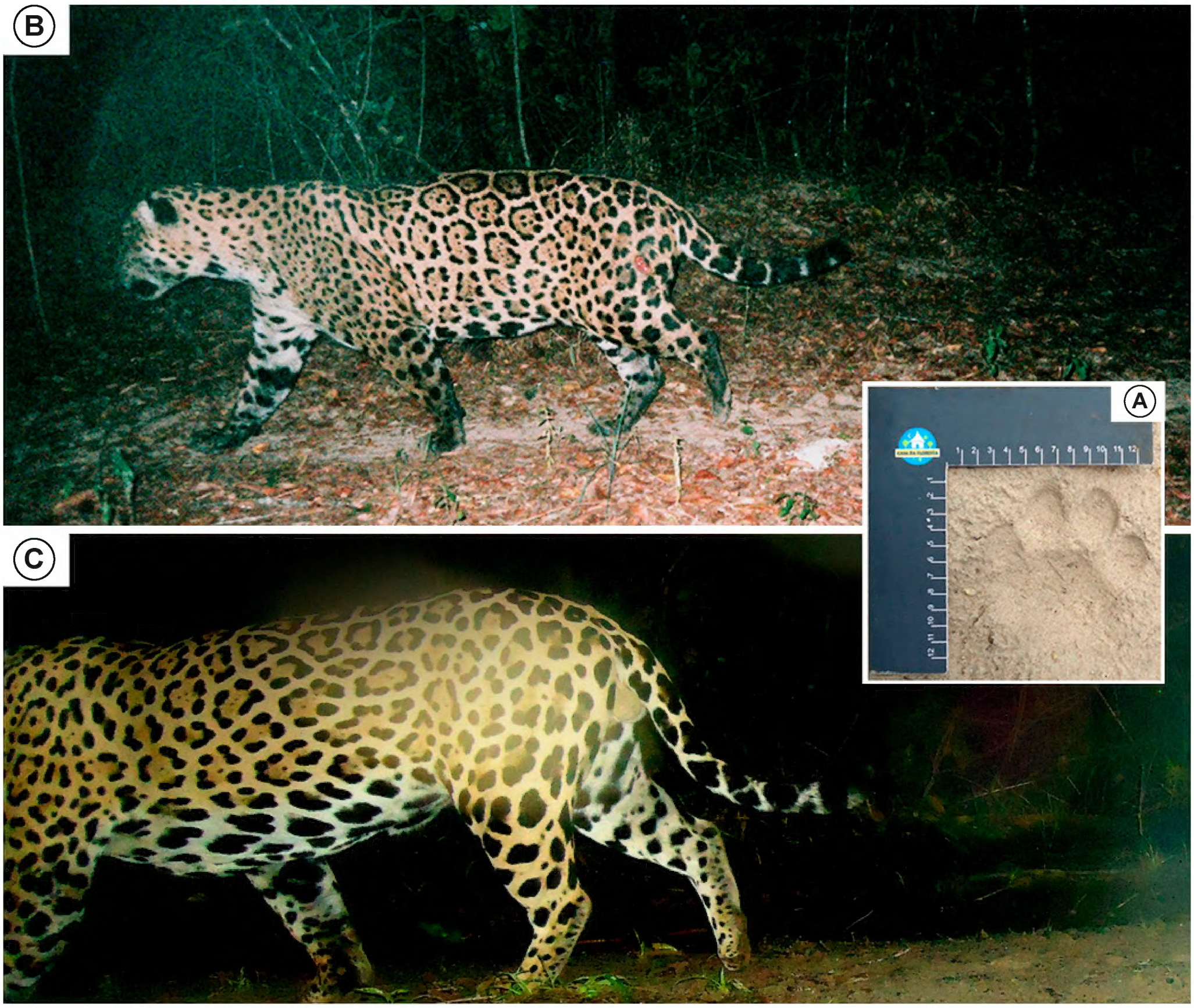

FIGURE 2. Records of *Panthera onca* jaguar in Três Lagoas, eastern Mato Grosso do Sul State (MS), Brazil. (a) footprint obtained in February 2011 on Barra do Moeda Farm; photographs obtained with trap-camera (b) in May 2011 on Barra do Moeda Farm, and (c) in June 2012 on Perdizes Farm.

In general, the forestry areas in Brazil are located on land with previous historic deforestation, replacing other cultures, especially pastures and sugar-cane culture; it is a reflex of environmental certifications, which do not encourage the conversion of native vegetation for commercial forest plantations. Thus, until a recent past, the timber production units were concentrated on southwestern (São Paulo, Minas Gerais and Espírito Santo States), on the south (Paraná and Santa Catarina States) and northeast (Bahia State) of the country, where the *Panthera onca* is practically extinct (Beisiegel *et al.* 2012; Moraes 2012) – two studies with medium and large mammals in interior areas of São Paulo State, confirmed this for Cerrado (Lyra-Jorge *et al.* 2010) and Atlantic Rainforest (Dotta and Verdade 2011) biomes.

Although a silviculture matrix is present, the areas where the species were registered have relatively large areas of protected native vegetation and are interconnected with protected areas from neighboring farms, forming an ecological corridor on the banks of the Paraná and Sucuriú rivers. Additionally, we had recorded high densities of other mammals (peccaries, deer, and armadillos) in these regions, preferred prey for large felines (Garla *et al.* 2001; Weckel *et al.* 2006).

There is a lack of information on jaguar dispersion or large movements among remote fragment habitats (Rabinowitz and Zeller 2010). In forestry matrix, this become worse because there are few studies in this landscape type, and there are not records of this feline (Lyra-Jorge *et al.* 2010; Dotta and Verdade 2011). Thus, our records suggest that *P. onca* could use this matrix, maximizing its ability to disperse, which is quite limited in altered areas (e.g. pastures), and it strongly affects the species due to gene flow loss (Haag et al. 2010). Moreover, our results indicate that this matrix can be more permeable than others, due the structure of *Eucalyptus* plantations (Antongiovanni and Metzger 2005), the presence of forest corridors (Laurance *et al.* 2008) and the high conservation value of forest plantations (Fonseca *et al.* 2009), and must to be further studied about capability to maintain survival of jaguar subpopulations.

Additionally, the formalization of occurrences of this species at these sites is important to include in future impact studies and environmental licenses, allowing the species to be incorporated into plans for fauna conservation and long-term monitoring.

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